



2004 AUTO-ID SHOWCASE

The Need for Traceability



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**Technology Transfer
Department**

**NASA Marshall Space Flight
Center**

May 20, 2004

Traceability May Be Best Defined By What It Is Not

Logistics

Inventory

Tracking

Control

Movement

Product ID

Networks

Databases

Authentication

Reports

Auto ID

Technologies

Standards

**But These Are Enablers in the
Environment Through Which a
Product Progresses**

A Better Way To Look at Traceability Is:

As Two Words:

Trace Ability:

.....or having the ability to determine the
quality, quantity, characteristic, and
course or development history of
something...to its point of origin if
required....***IT'S PEDIGREE***

Traceability of Critical Parts Automotive and Aerospace

**The Automotive Industry and Aerospace Do Things
Differently at Times and the Same Sometimes**

**The Automotive Industry and Aerospace Each
Have Their Own Sets of Problems
and Probably Would Not Want To Trade**

**But the Automotive Industry and Aerospace
Make an Interesting Comparison**

And It Was a Fun Story To Put Together

Traceability of Critical Parts Automotive and Aerospace

Things in Common

Things Not in Common

- | | |
|----------------------------------|--------------------------------|
| ● Transportation | ● Acceleration and speed |
| ● Six Passengers | ● Cost |
| ● Aerodynamic Styling | ● Production Rate |
| ● Destination Oriented | ● Size |
| ● Engines and motors | ● President's Vision |
| ● Quality | ● The Detail of |
| ● Traceability of Critical Parts | Traceability of Critical Parts |

All Traceability Requirements Are Not Created Equal

But All Must Be Satisfied...For the Good of the Customer

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Traceability of Critical Parts Automotive and Aerospace

**Be Happy with the TREAD Act
It Could Be Worse**

Using Aerospace Traceability Requirements, A New Pickup Truck:

**Would take a month to build
Would cost millions
Could not carry the paper trail of traceability**

UNIMAGINABLE!!

But for NASA to survive in the Automotive Industry environment:

**Could not start to deal with configuration management
issues after vehicle delivery, shade tree mechanics, aftermarket
suppliers, counterfeiters, knockoffs, junk yards.**

UNIMAGINABLE!!

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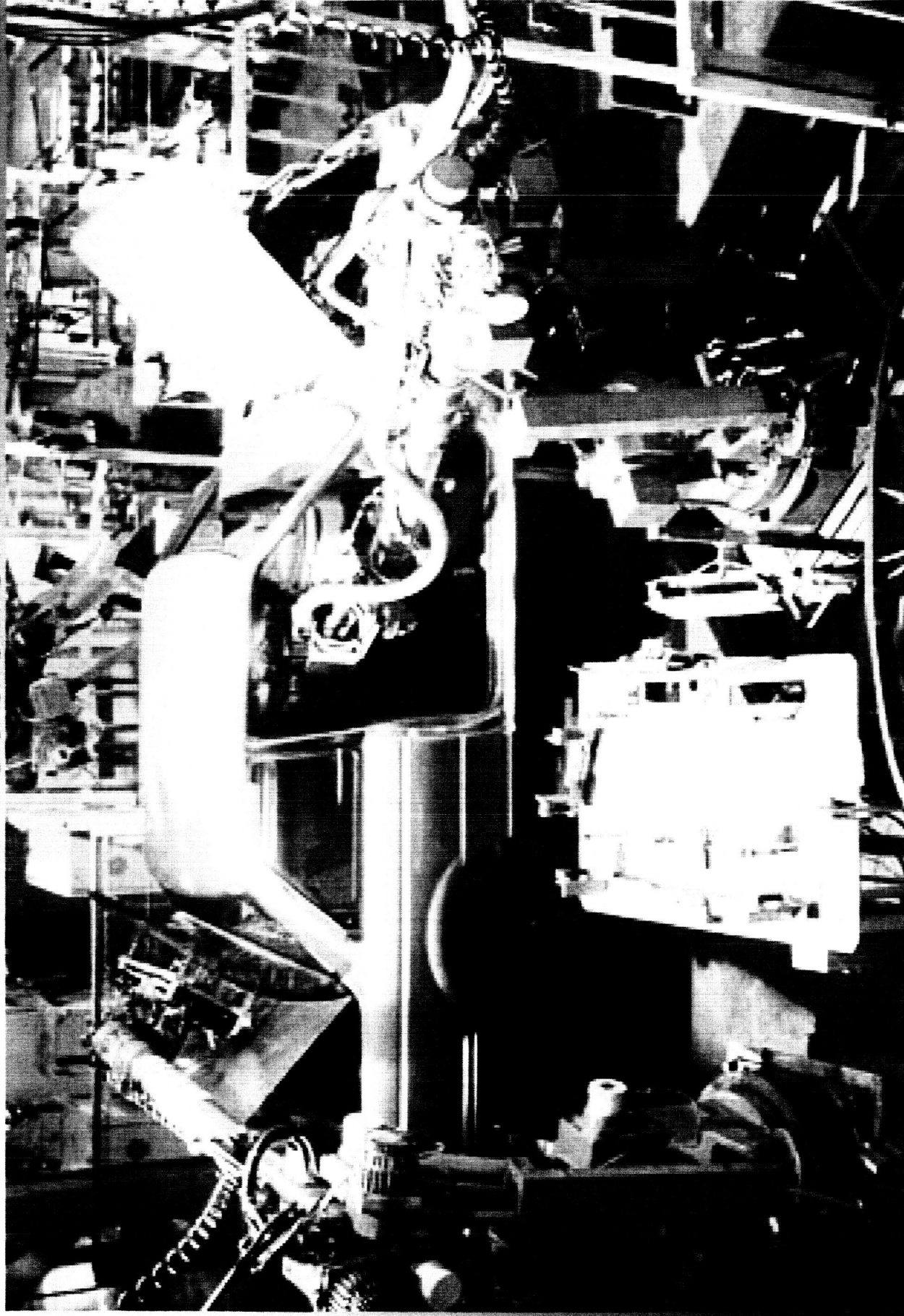
Traceability of Critical Parts It Could Be Worse

The Automotive Industry Could

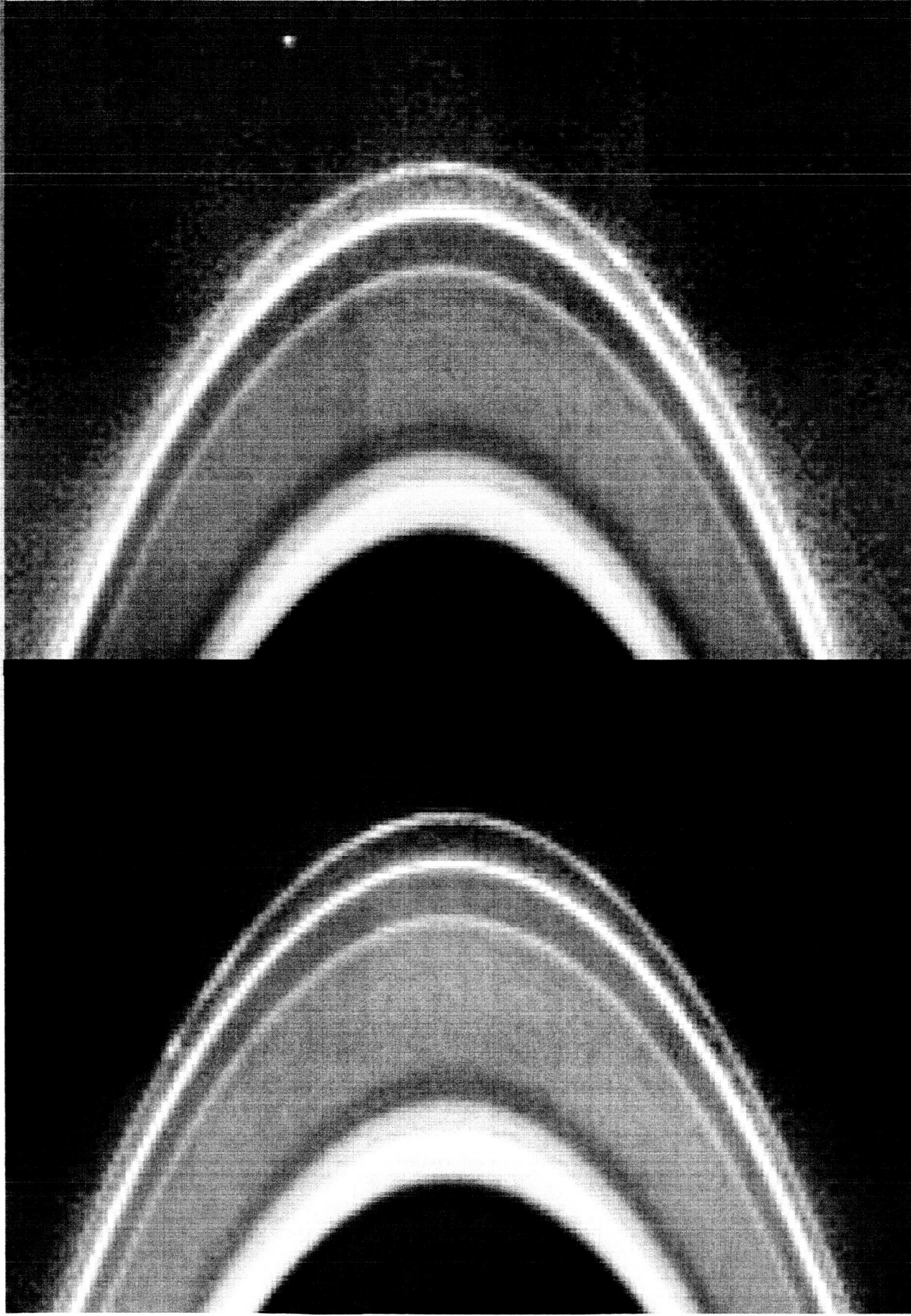
Build It Right...

You Already Have

Automotive Industry Space Vehicle in Production



NASA Curious About Lumps on Rings of Saturn



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Cassini Sent to Investigate



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Automotive Industry Exploring New Markets



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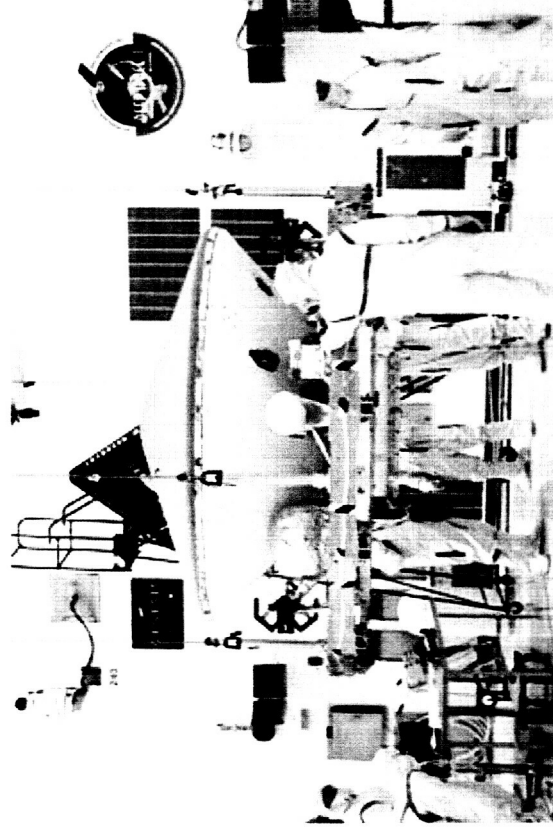
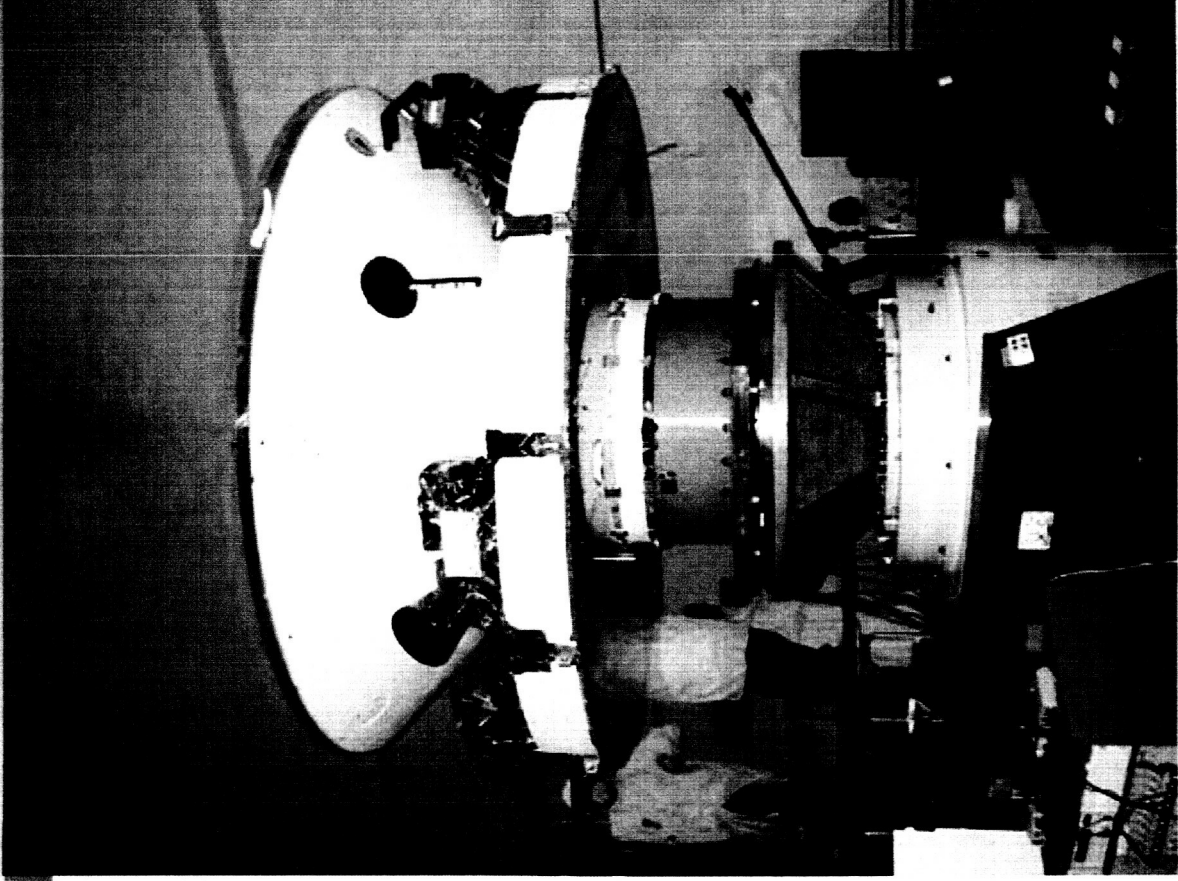
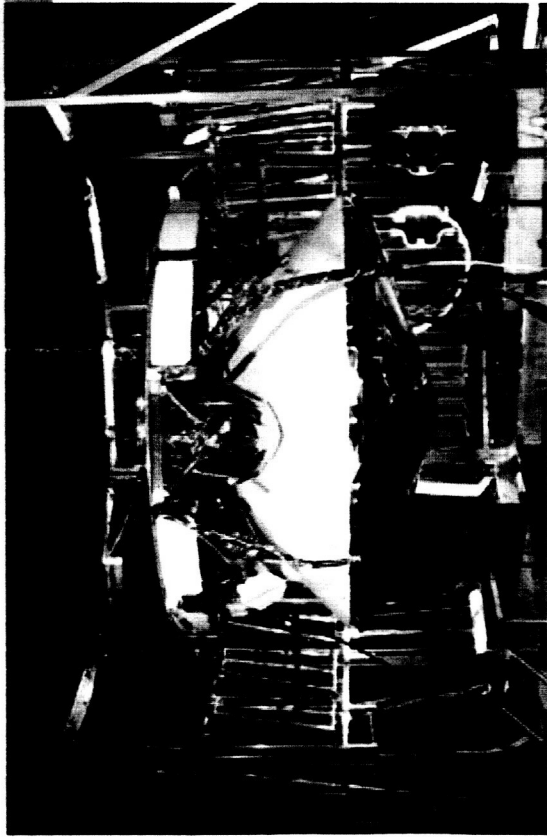
Traceability of Critical Parts It Could Be Worse

The Aerospace Industry Could

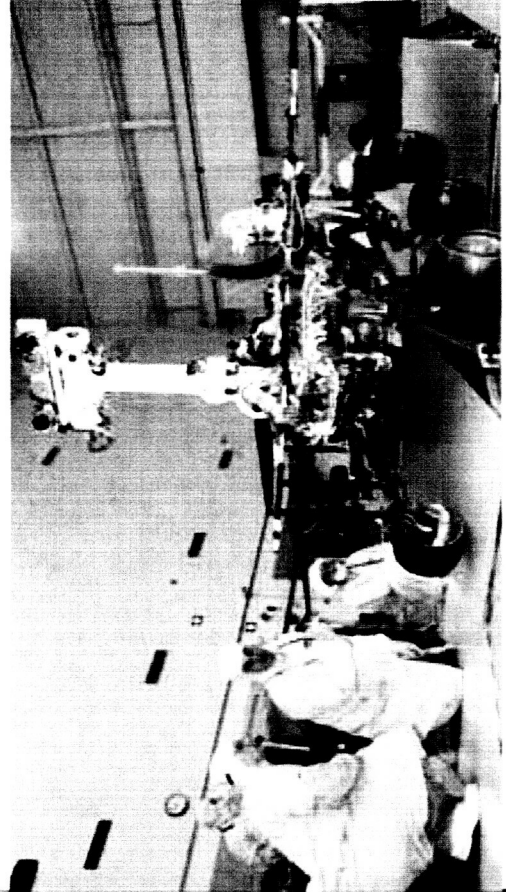
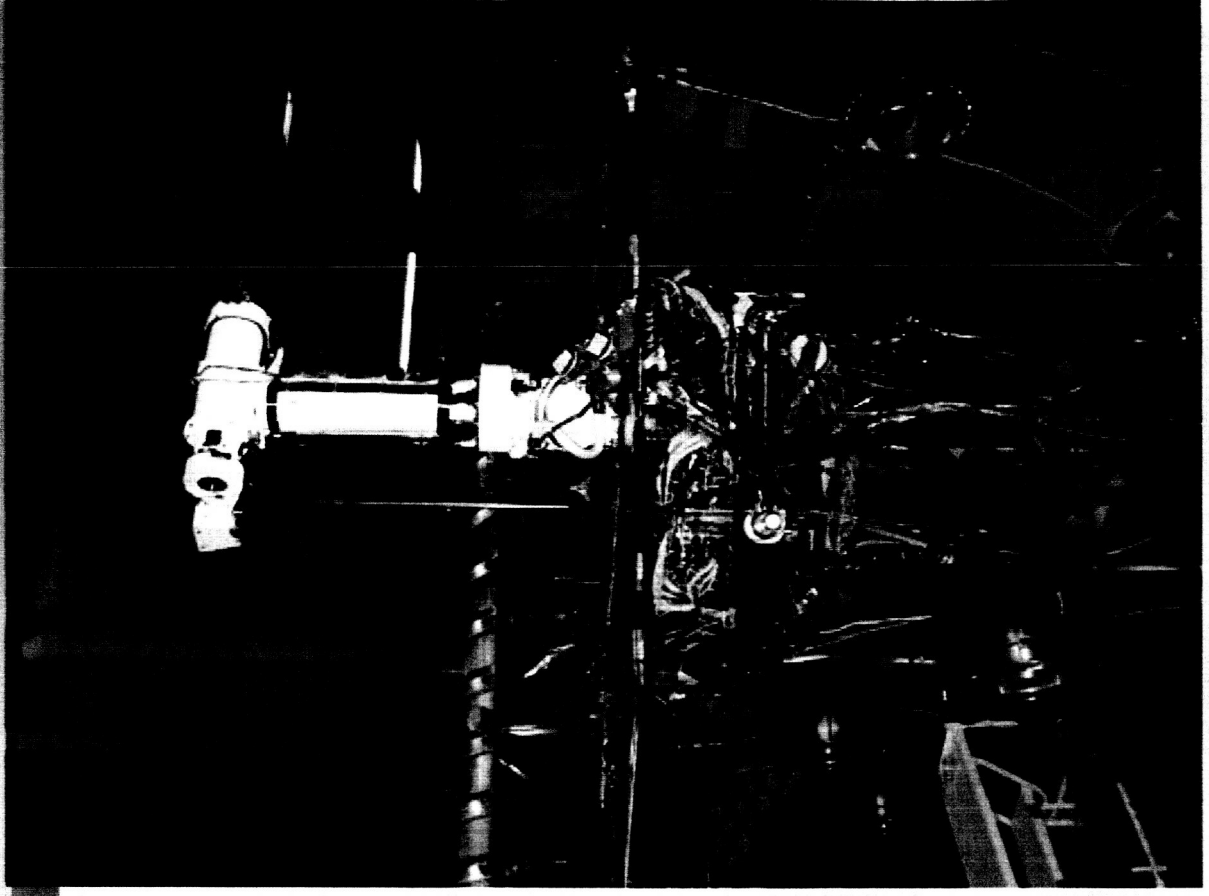
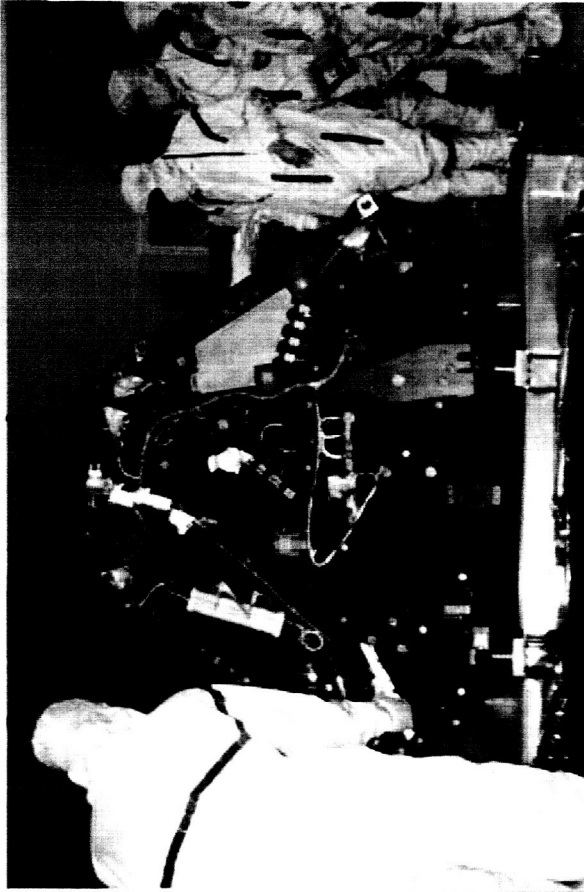
Build a Better...

We Already Have

New Delivery System Was Required



New SUV Was Produced



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Revolutionary New Brake System

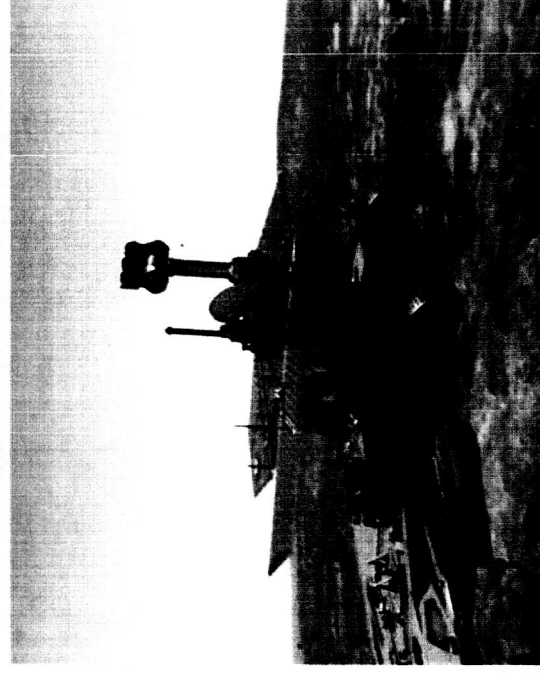
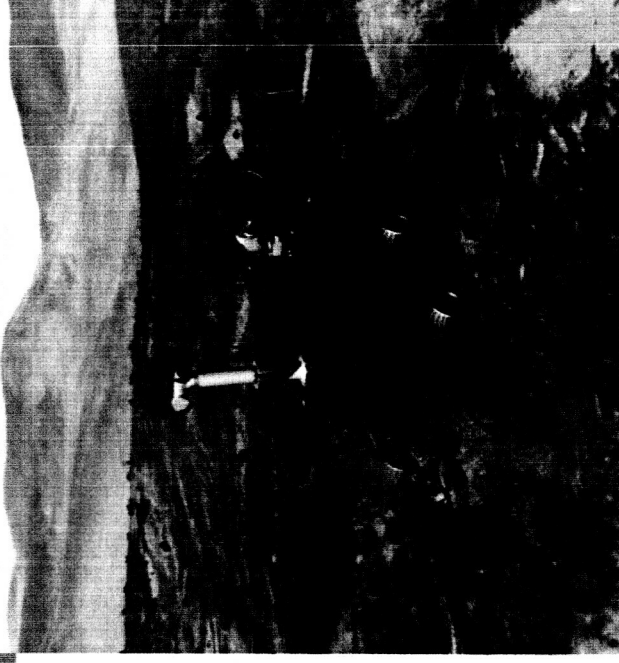


Revolutionary New Shocks, Too

Use Once and Discard



Catchy Name—Mars Rover "Land Rover" Already Used



Traceability Requirements

Anyway, Welcome to the Club

Aerospace Had Traceability Requirements Since 1960

Traceability for Every Piece of One Vehicle
Every Few Years Has One Set of Problems

Automotive Had Traceability Requirements Since 2000

Traceability for Several Pieces of Thousands of Vehicles
Every Day Has Another Set of Problems

Each New Technology Will Make It Easier

TREAD Act

Components/Systems to Report

- **Steering**
- **Suspension**
- **Service brakes**
- **Parking brakes**
- **Engine and cooling system**
- **Fuel system integrity**
- **Power train**
- **Electrical system**
- **Lighting**
- **Visual systems**
- **Climate control including defroster**
- **Airbags and related components**
- **Seatbelts and related components**
- **Seat**
- **Engine speed control**
- **Integrated child restraints**
- **Latches**
- **Tires**
- **Wheels**
- **Trailer hitches**

Can you imagine these systems and their components all serialized, tracked for life, configuration maintained when parts were replaced. When the system or component design life expired, the vehicle on which it resided would be held until the system or part was replaced.

Well, that's Aerospace



TREAD Act:
Early Warning
Reporting

The Perfect Storm

November 1, 2000

*Transportation Recall Enhancement, Accountability,
and Documentation Act (TREAD Act)*

Ford Aware of Venezuela Tire Defect in 1998

■ **Safety:** The auto maker and Bridgestone Firestone also are under siege from the Florida attorney general.

From Times Wires and Staff Reports

CARACAS, Venezuela — Ford Motor Co. said Tuesday that its first report of problems with Firestone tires on Explorer sport-utility vehicles in Venezuela came in 1998 — two years before it began replacing

Ford Had Data On Tire Safety, Records Show

By SHARON PERRY

And LOUISE R. WHITE

Staff Reports of The Wall Street Journal

WASHINGTON — Ford Motor Co. documents indicate that company officials had

data that Firestone tires installed on Explorer sport-utility vehicles had little or no

margin for safety at top speed during at

the UN procedures Ford recommended.

The papers were part of a collection of

documents that congressional investigators

released late yesterday ahead of 30-

year release of documents from the

Traceability of Critical Parts Tragedy and Response

- **Law Maker Response.... Legislate TREAD**
- **Auto Industry Response.... Use AIAG**
- **AIAG Sponsors AutoTech and Showcases**
- **Implementers of TREAD Attend Today**

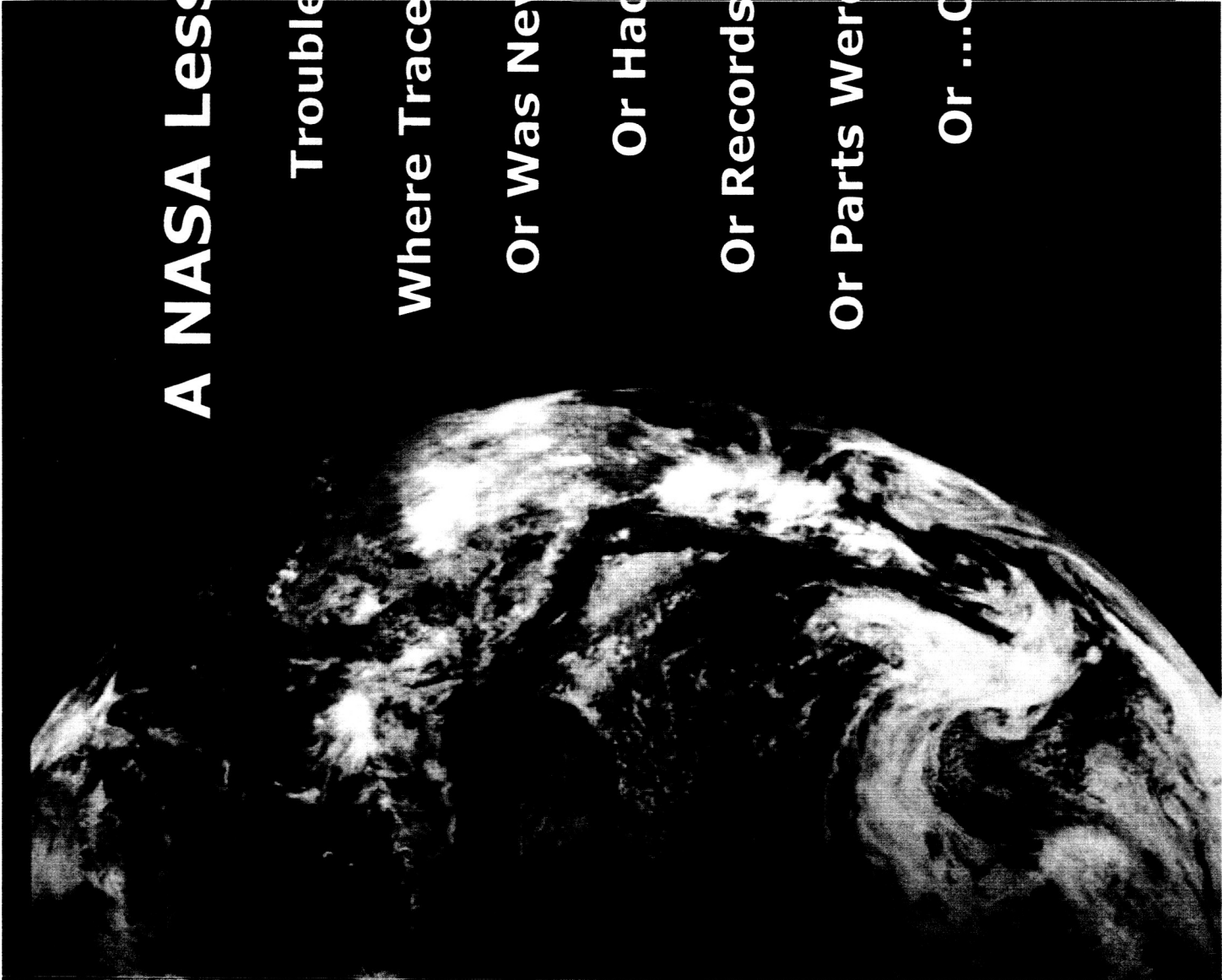
How Far Can You Go Nowadays Without Traceability

Not To The Moon Or Mars

Not Even Off The Launch Pad

Not Out Of Detroit

Not Even Off The Assembly Line



A NASA Lesson Learned

Trouble Starts

Where Traceability Stops

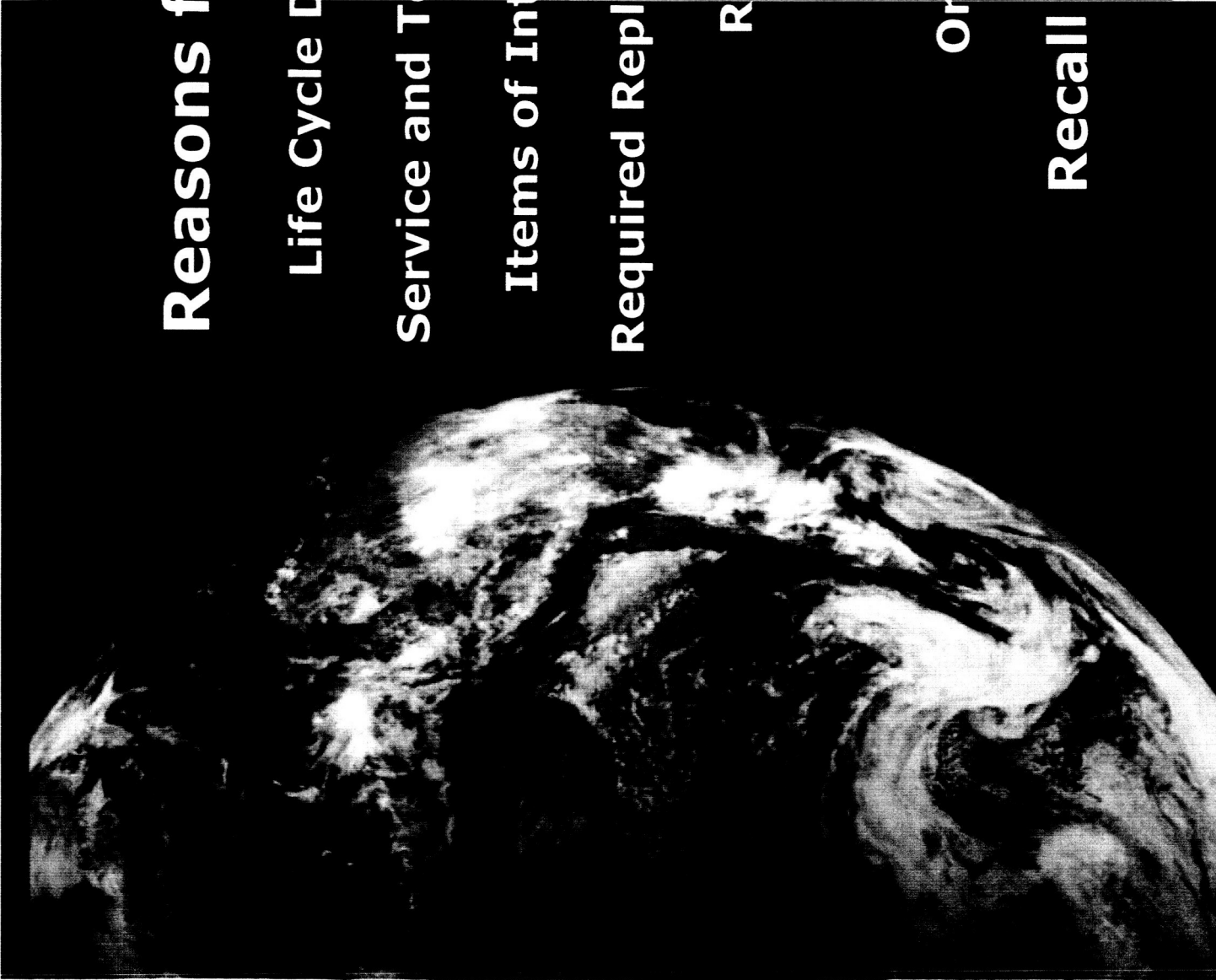
Or Was Never Started

Or Had Gaps

Or Records Were Lost

Or Parts Were Not Marked

Or ...Or...Or



Reasons for Traceability

Life Cycle Design and Testing

Service and Test Results Feedback

Items of Interest in Broad Use

Required Replacement of Bad Parts

Reliability

Safety

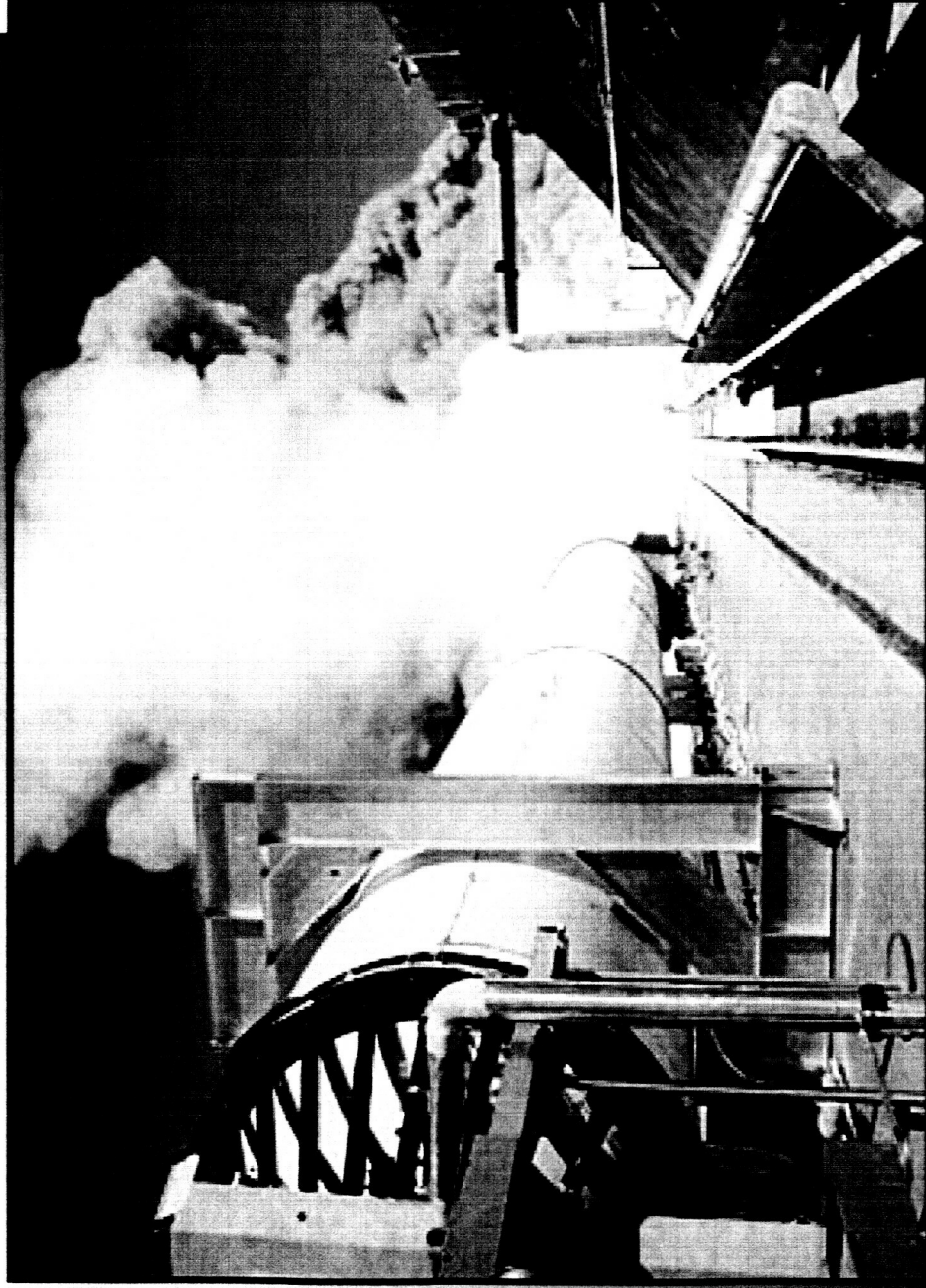
Or ...Or...Or

Recall or Litigation

Traceability of Critical Parts Why It Is Important To NASA

- **Design Safety Factor of 1.4+**
- **Continued Testing to Validate Safety Factor**
- **Fleet Leader Condition (What Is Failing)**
- **Where Are All the Parts Like the Failed One**
- **How Do Only the Bad Ones Get Replaced**

Traceability of Critical Parts Test for Life Extension



Learn to Test

Test to Learn



ETM-3.wmv

Failures Provide

Recall Information

This and other RSRM information compliments of:



_____ ATK THIOKOL PROPULSION

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Elements of Traceability

As-Designed Database

As-Built Database

As-Maintained Database

Communication Network

Participant Dedication

New Part Identification

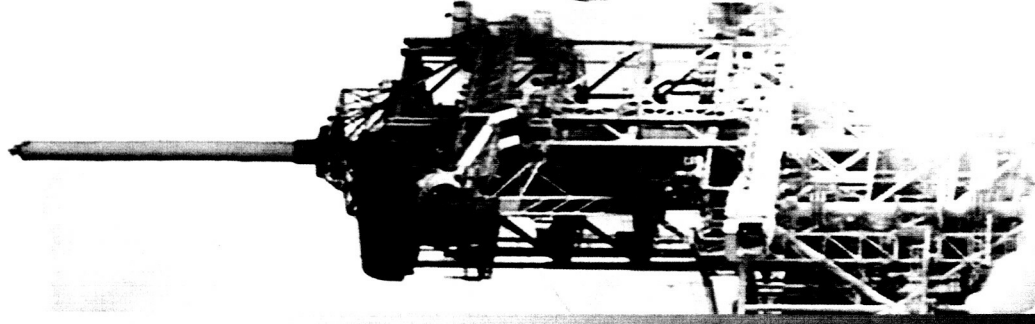
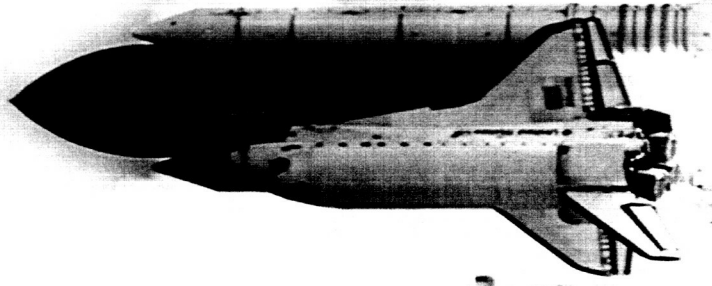
In-Service Part Identification

Part Authentication

Everything Working Together

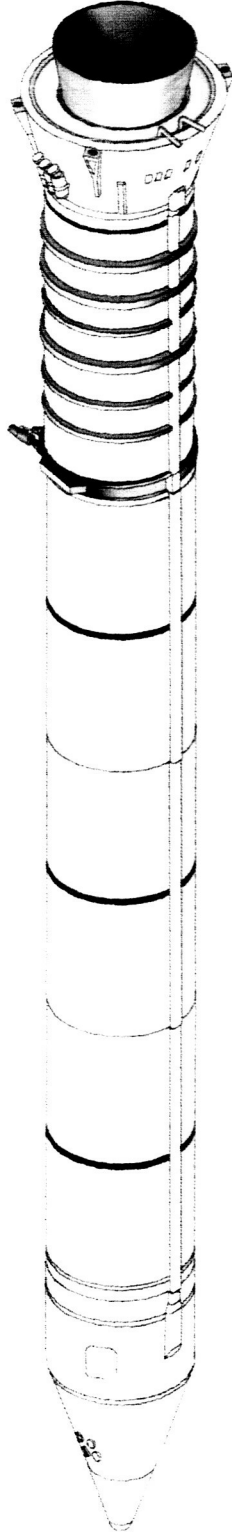
Traceability of Critical Parts Requires a Reliable Database

- Prime Contractors Required To Keep Engineering and Configuration Databases
NASA Has Complete Access
- Engineering Tracks Life and Condition of All Parts
- Configuration Tracks Location and Status of All Parts
- Pieces Are Traceable to Parts to Assemblies to Components
--- And All to the Vehicle

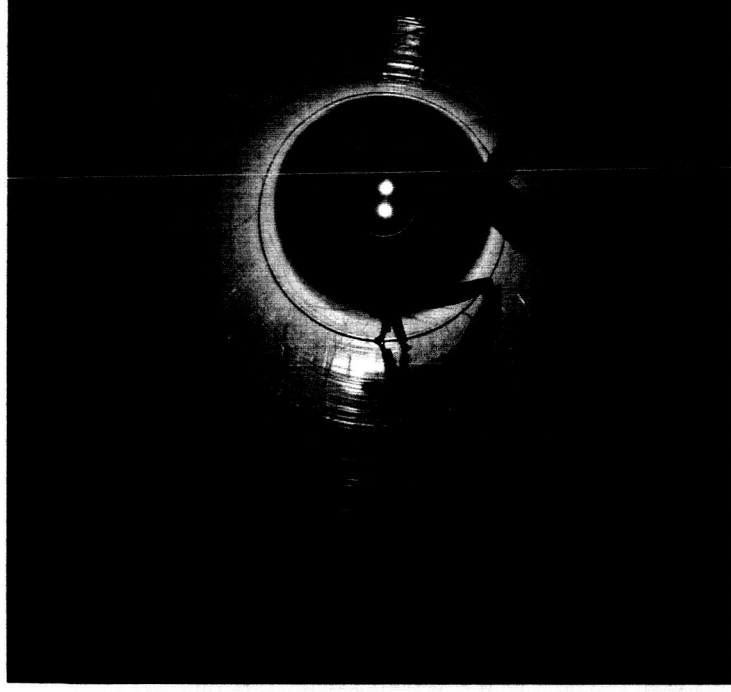


Traceability of Critical Parts

Reusable Solid Rocket Motor

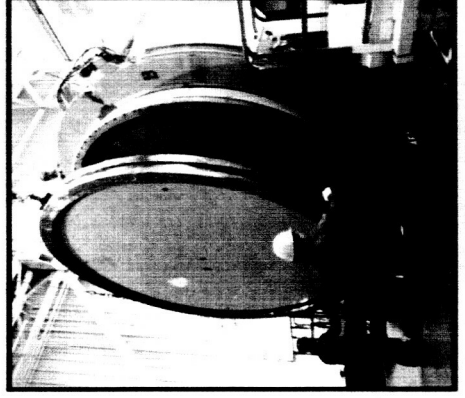
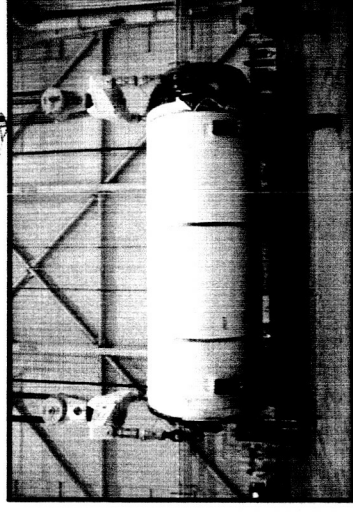
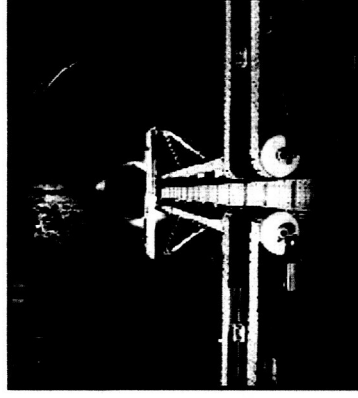
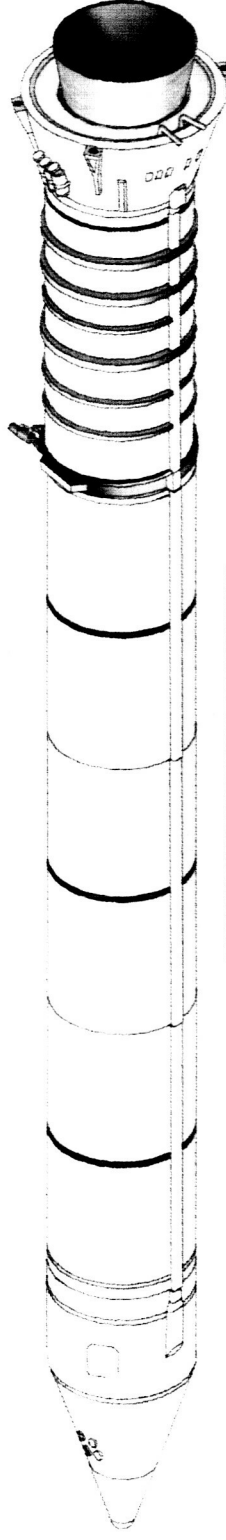


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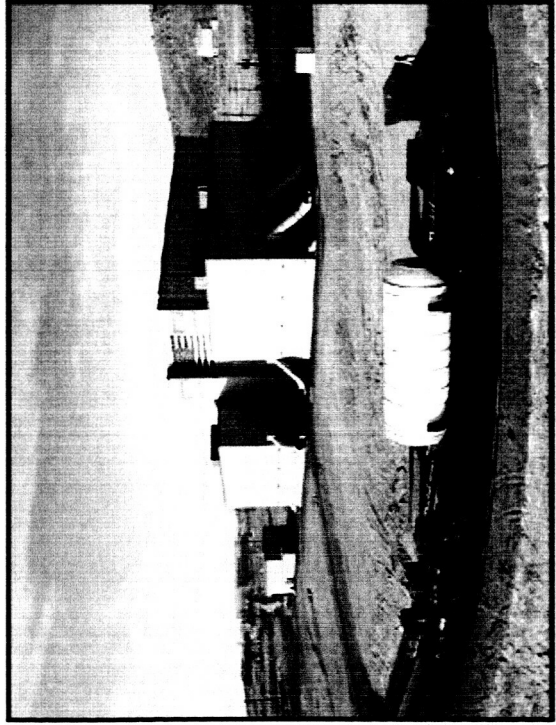
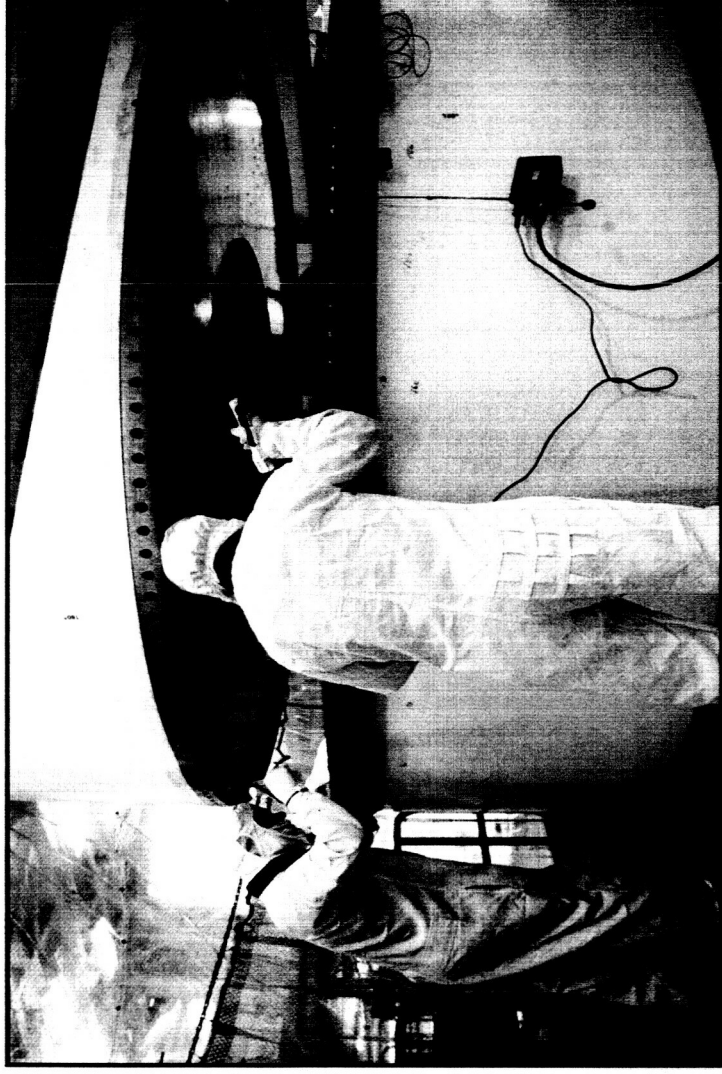
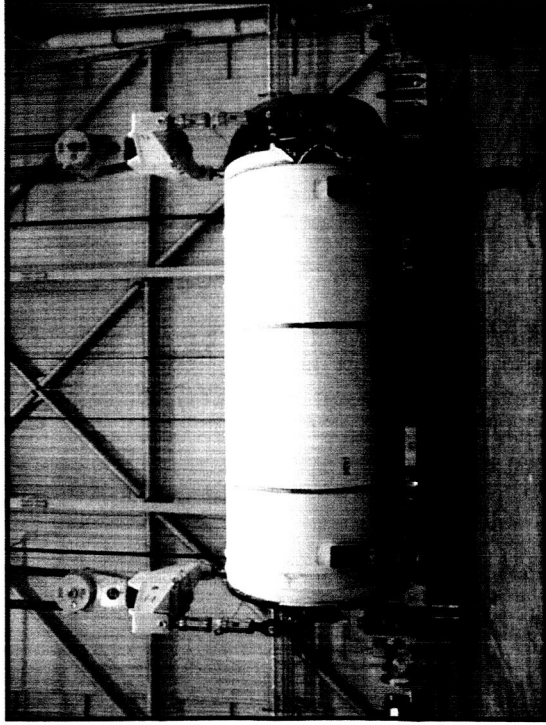


Traceability of Critical Parts

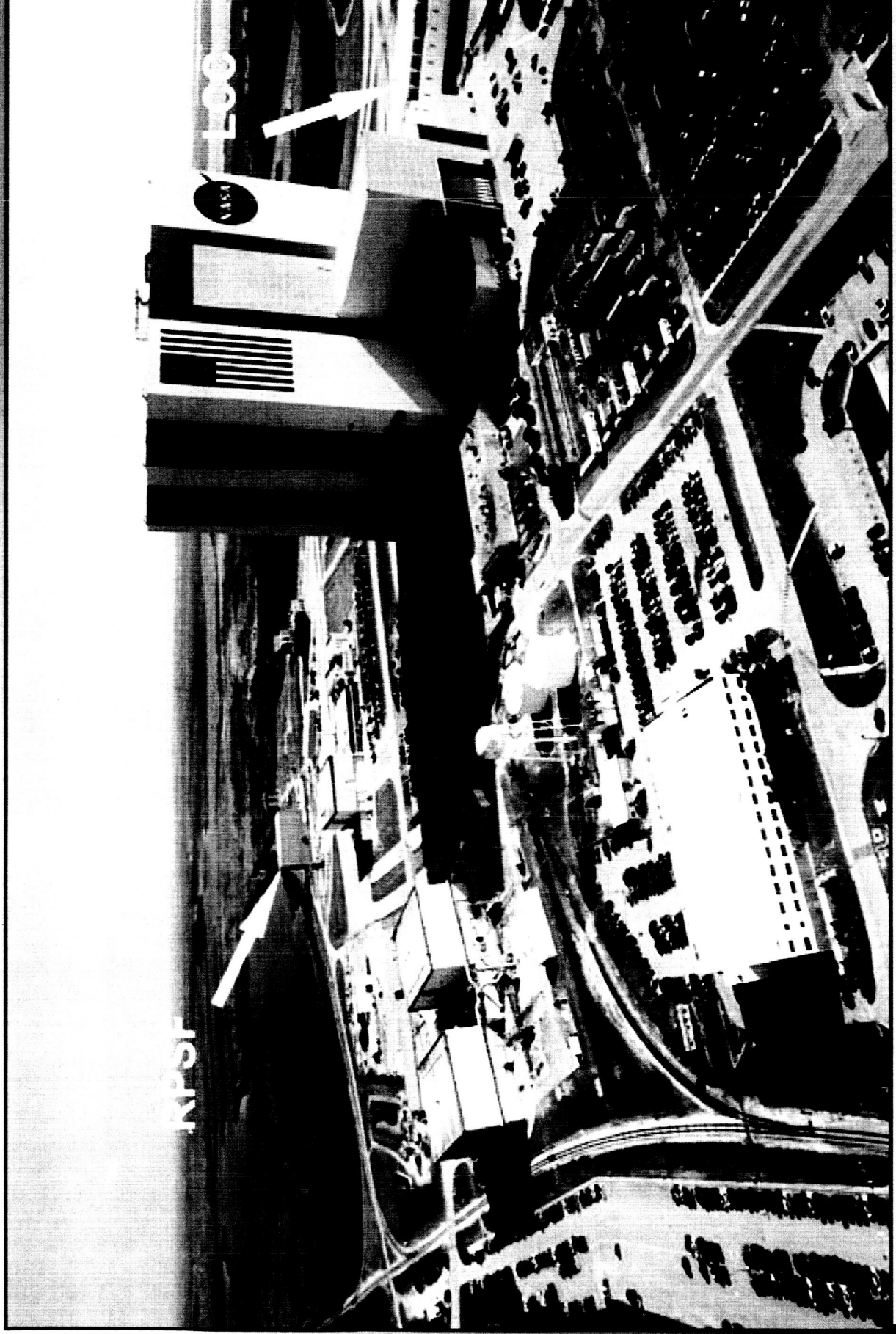
Reusable Solid Rocket Motor



Traceability of Critical Parts



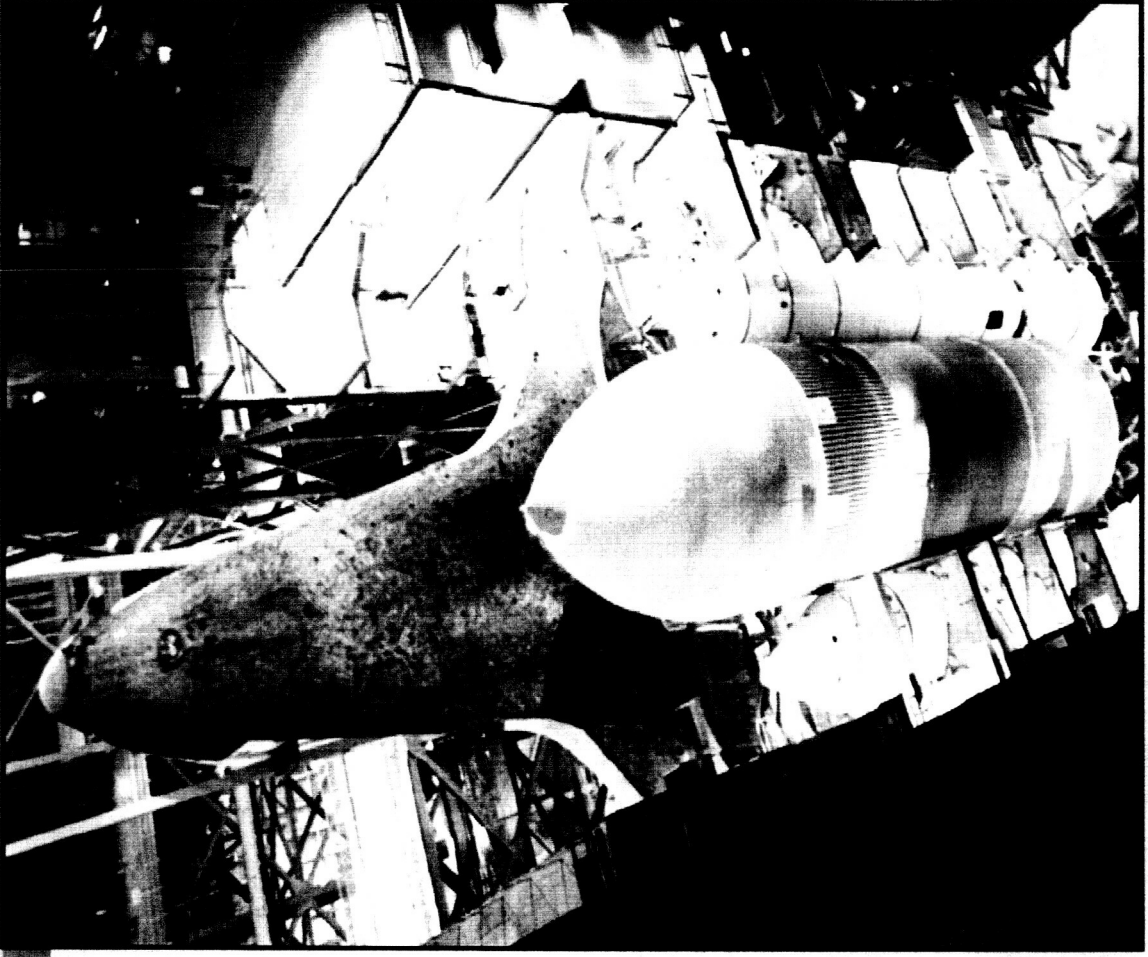
Traceability of Critical Parts



Traceability of Critical Parts

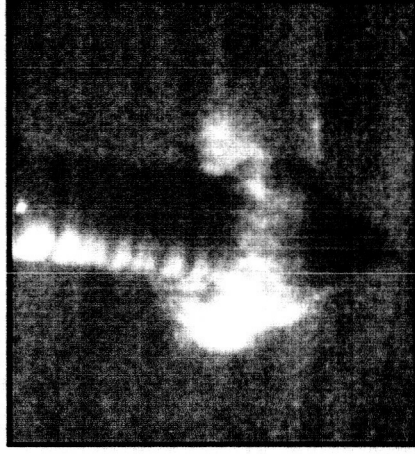
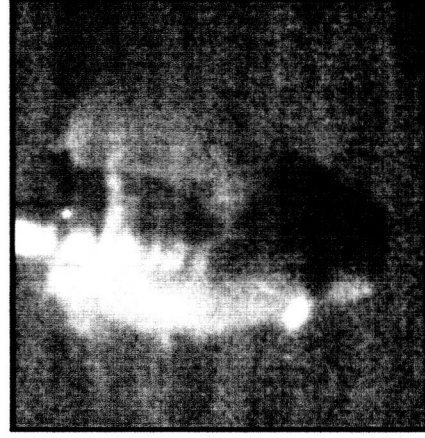
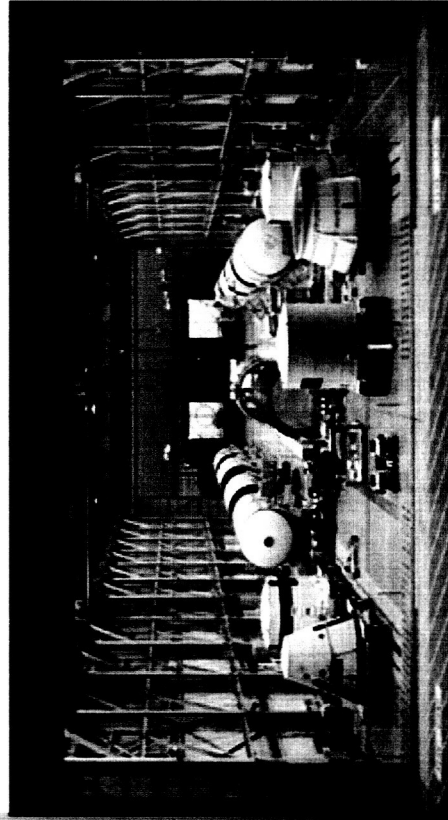
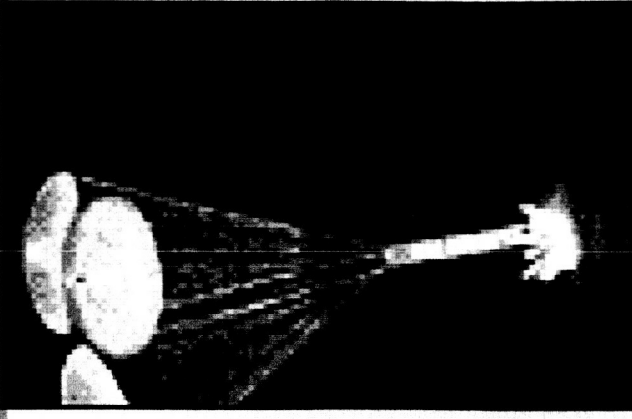
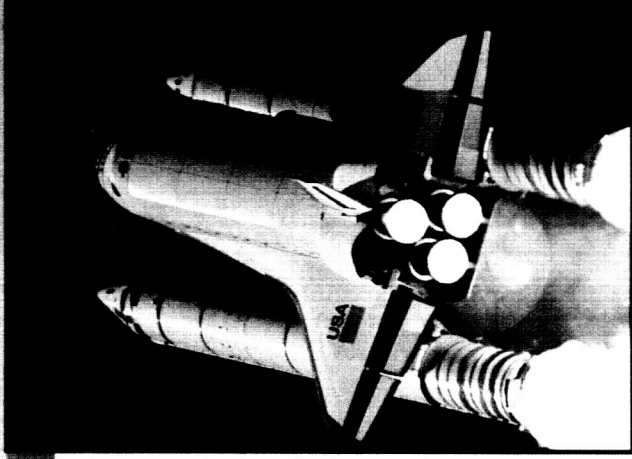
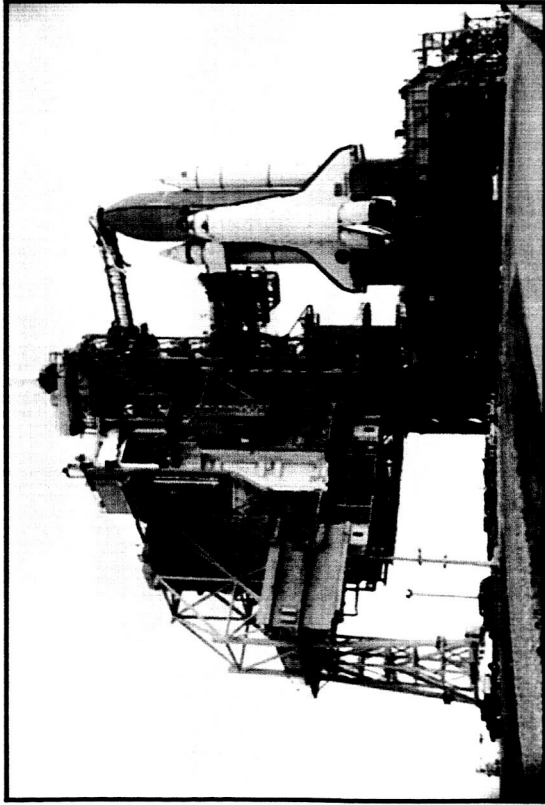


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Traceability of Critical Parts



Traceability of Critical Parts Starts with Identification

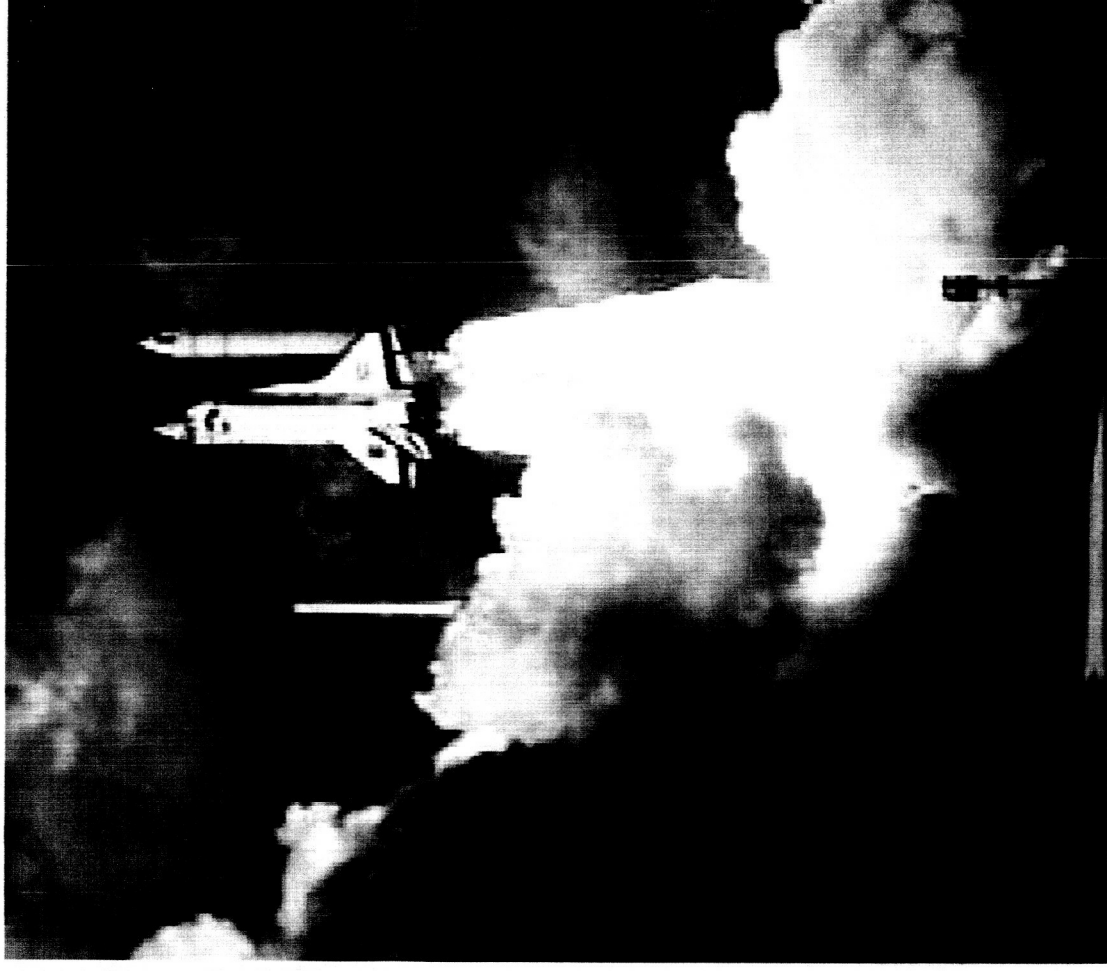


DAIMLERCHRYSLER

*Part Numbers and Serial Numbers
Identify One Part From the Other*

*CAGE Numbers Identify One
Supplier from the Other*

*More Technology Is Needed
To Identify
A Genuine Part from A Counterfeit*



Automatic Identification Used at Many Levels

Bar Coded Labels That Are Adhered to or Printed on the Product

Direct Part Marked Visible Permanent Identification

Direct Part Marked Hidden Permanent Identification

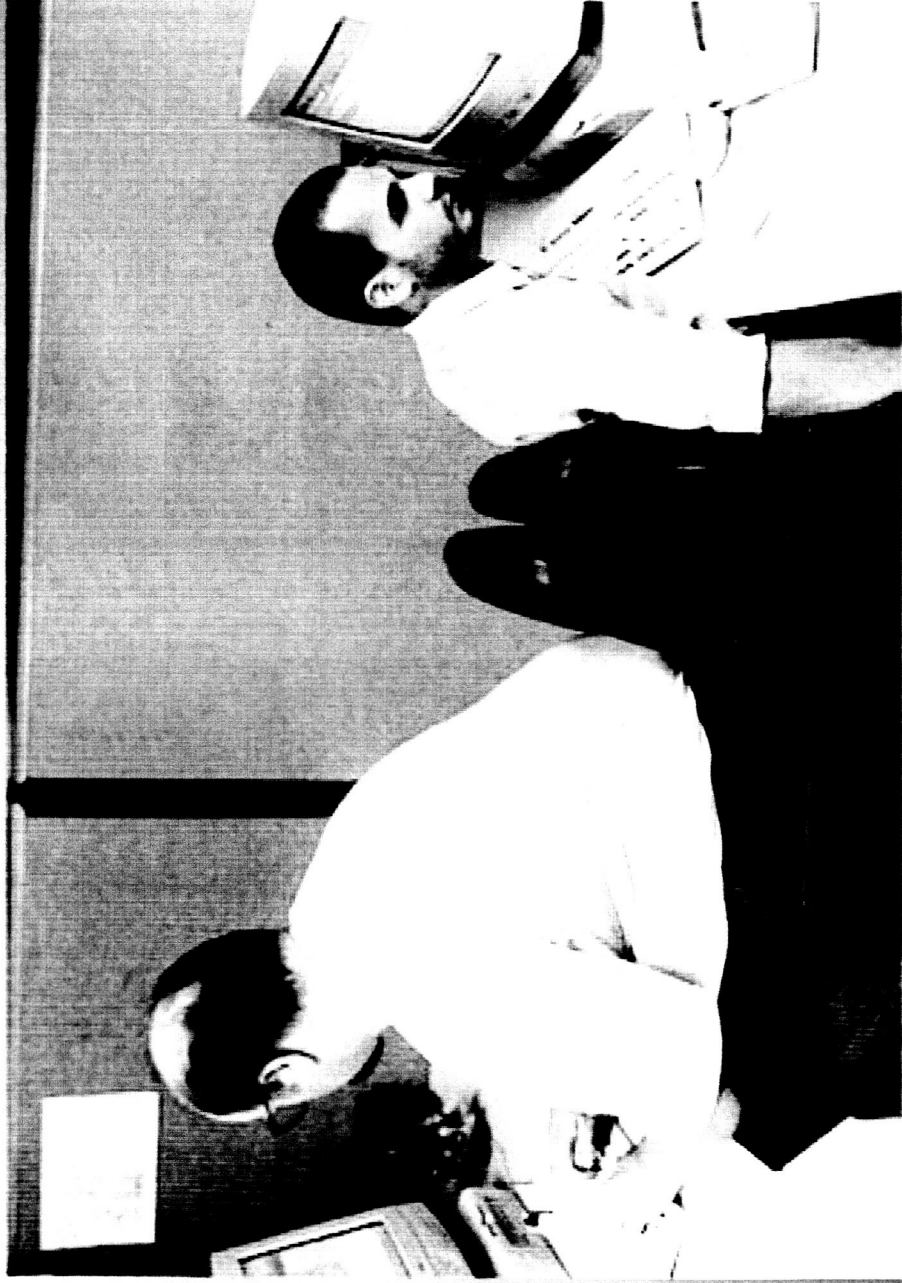
RFID

Intrinsic Identification



*All Technologies Must Work Together In the IT World....
Traceability Depends On Automatic Identification Working
With Automatic Communication For The Right Results*

Automatic Identification Choices



Bar Code
Labels
Are
Cheap...
Mature...
Reliable...
Widely Available
Technology

Use Bar Code
Labels
Where You Can

But If There Is Not Room for a Bar Code Label...Use 2D

Product ID Problems That Inhibited Traceability

- **Direct Part Mark 2D Symbols**
- **No Contrast Marks**
- **Curved and Shiny Surfaces**
- **Distance Reads**
- **Symbols Covered with Paint**
- **Chemical Tags Not Used as Codes**

So We Quit Complaining and Started Developing Solutions

Someone Has To Be First

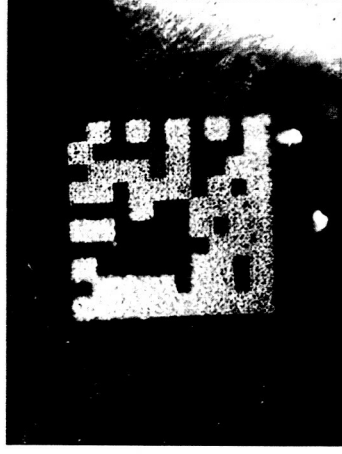
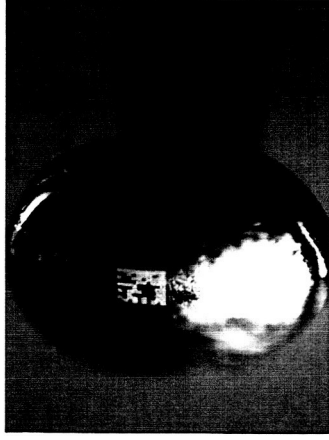


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Direct Part Marking

Direct Part Marking

NASA's Primary Emphasis
....Item-Level Traceability
....Track the Piece



Left: 10x10 matrix symbol on the head of a straight pin

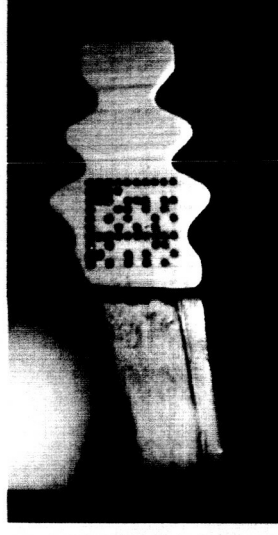
Below: 10x10 matrix symbol on the side of a turbine blade

Know the Pedigree

....Know who made it

....Know who marked it

....Know who stands behind it



Automatic Identification Starting Points

All ID Must Work Together

PART NO.
(P)

100796553



QUANTITY
(Q)

2500



SUPPLIER
(V)

04089875



SERIAL
(S)

0000005

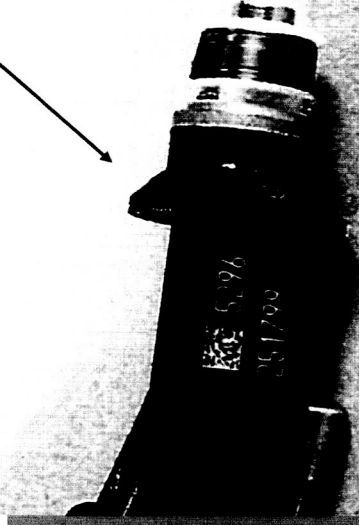
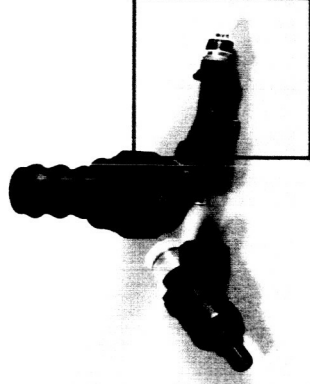


XYZ COMPANY, INC. ANYTOWN, USA 48754

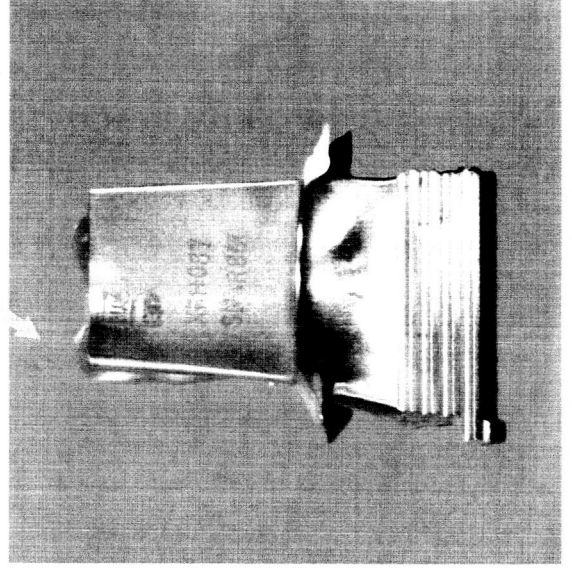
Bar Code

Data Matrix

Human
Readable



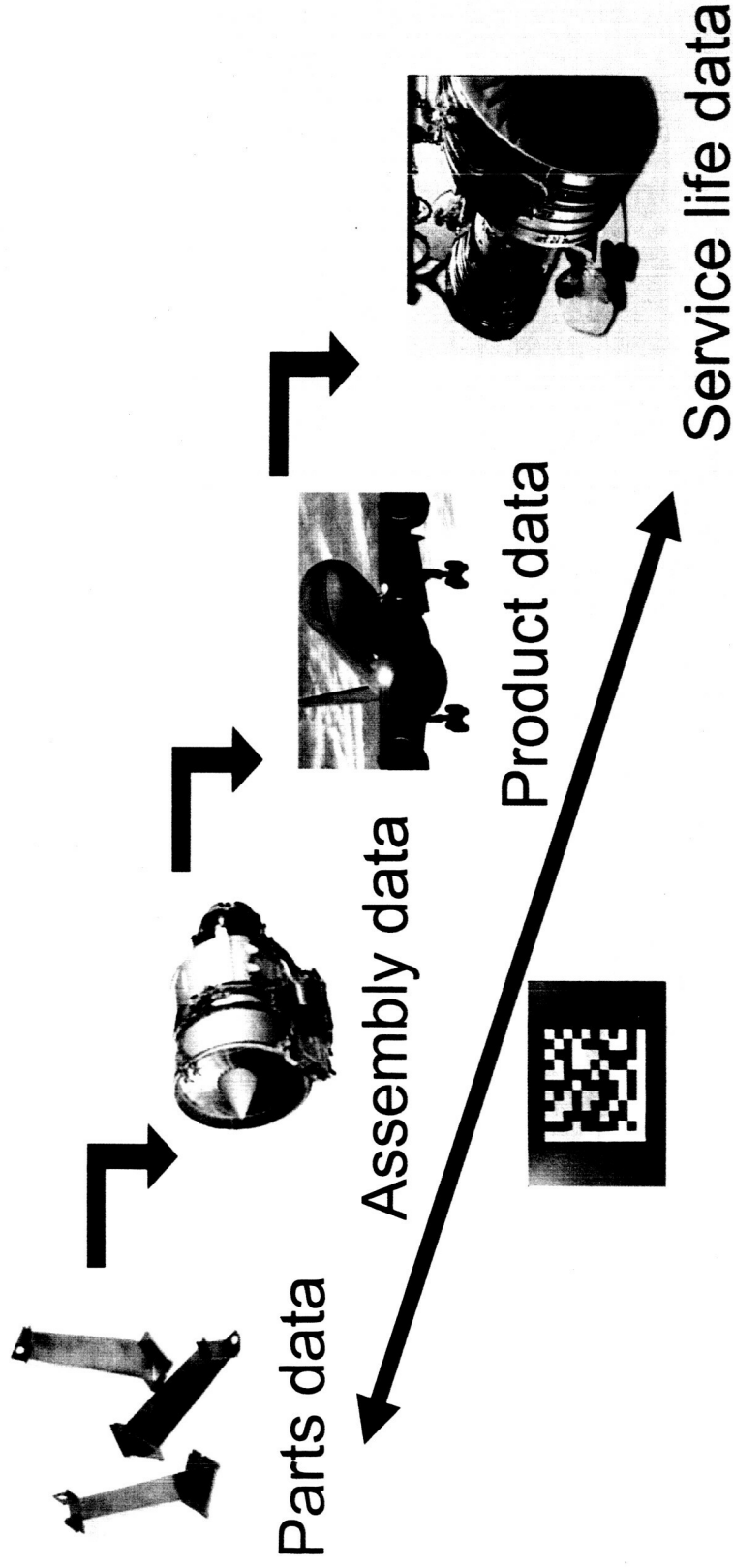
Fuel Injector



Space Shuttle
Main Engine

Turbine Blade

Direct Part Marking Enables Life Cycle Tracking



Data Matrix Codes Marked On The Parts Provide The IT Link

Additional Technology Enables Life Cycle Integrity

- **Counterfeiters Make a Look Alike**
- **Knock Offs May Not Even Look Alike**
- **Customer Blames OEM If Something Breaks**
- **Traceability Stops Where Cheating Starts**
- **Insurance Companies Should Love Traceability**

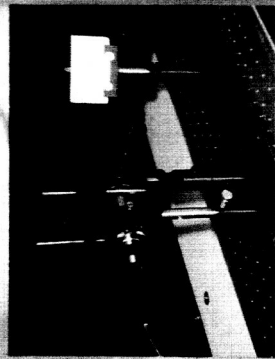
Additional Technology Enables Life Cycle Integrity

Use the Technology Available to You

Cheat

Cheaters

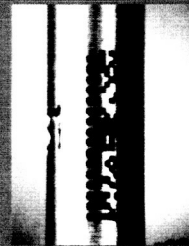
Product ID and Authentication Family Picture



**NASA Optical Scanner
For Visible Marks**

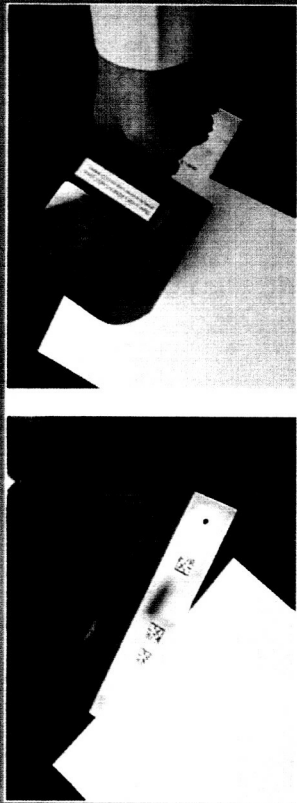


**No contrast mark
on smooth aluminum**



Shiny screwdriver

Read Through Paint



Magnetic

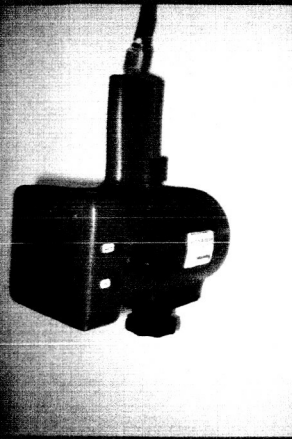
Intrinsic Identification Using X-ray Fluorescence

**Standard X-ray fluorescent
detection range Titanium +**

Na 11 sodium	Mg 12 magnesium	Al 13 aluminum	Si 14 silicon	P 15 phosphorus	S 16 sulfur	Cl 17 chlorine	Ar 18 argon
K 19 potassium	Ca 20 calcium	Sc 21 scandium					

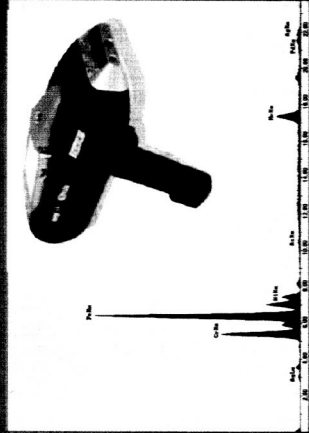
**XRF detection range using vacuum
adds Aluminum alloys +**

Ultrasonic



**Software converts to ASCII
and code of choice**

**X-ray fluorescent analysis
detects elements present**



Detects silicon contamination

**Detects elements used in
Pharmaceuticals**

New market leader for XRF

Authentication Technologies

*How does an OEM prove that
the part that failed was
not made by the OEM?*

XRF authenticates the product

CAGE Code.....5 Element Tag

**XRF converts formats and ties
to bar and matrix codes**

**XRF converted format is
transparent to IT systems**

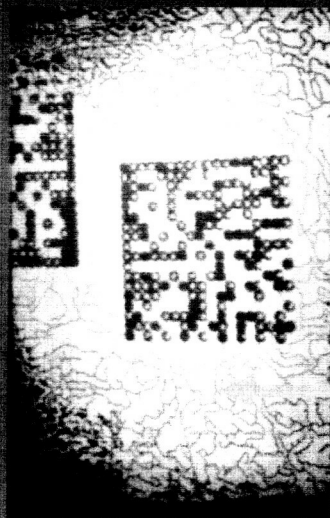
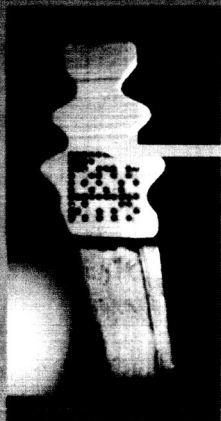
Intrinsic Identification



Product Validation and Authentication Automatic Identification Fully Integrated

(temporary to permanent to intrinsic marks for routine to the most secure
product ID and validation matching)

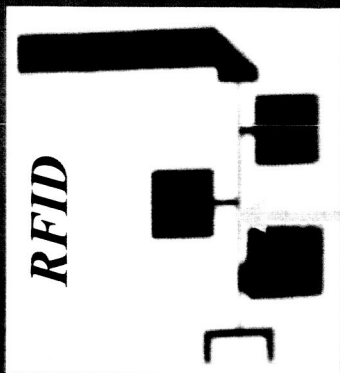
Direct Mark



Magnetic



Ultrasonic



RFID

PART NO
(A) 100796553

QUANTITY
(B) 2500

SUPPLIER
(C) 04089875

SERIAL
(D) 0000005

XYZ COMPANY, INC. ANYTOWN, USA 40754



XRF

*Five Levels of
Auto ID Work Together
Transparent to IT System*

**Blessed are the flexible—for they
shall not be bent out of shape**

Bar	Visible 2D	Hidden
Codes...	symbols...	symbols...

XRF	RFID...
authentication...	

**If all you need is a piece of technology to make things work...
Find the right supplier and complete your mission**

If you are just starting and need a lot of help.....

Consider hiring a company that offers SOLUTIONS...

Integrates the pieces that make sense for you...

And holds your hand until it works

Traceability Summary Automotive and Aerospace

- **Traceability Enables TREAD Responses**
- **Reliable Databases Required**
- **Reliable Product ID Required**
- **Reliable Communication Networks Required**

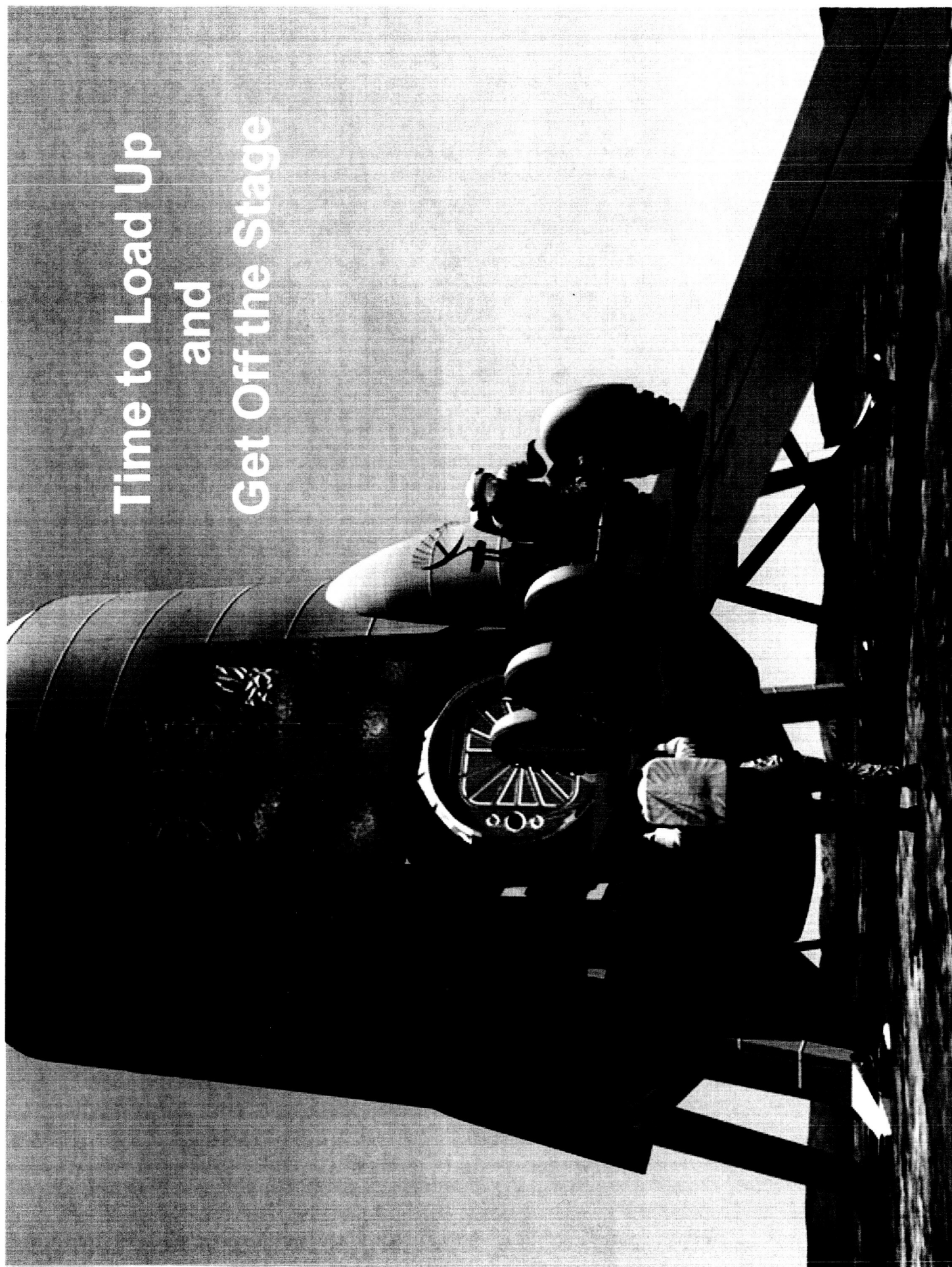
Life is NOT like a box of chocolates.

Life is like a jar of jalapenos.

What you do today

May burn your tail tomorrow !

Time to Load Up and Get Off the Stage



Thank You for the Detroit Hospitality



ΔiAG

